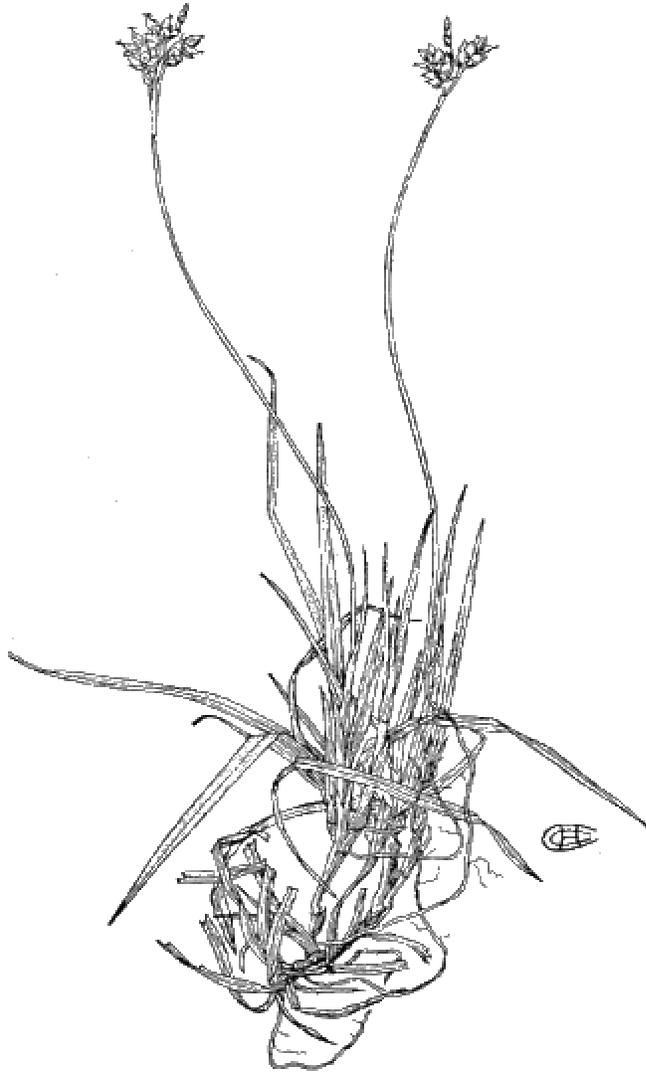


Draft *Carex concinna*

Draft Conservation Assessment
For
***Carex concinna* R. Brown**
(low northern sedge or beauty sedge)



USDA Forest Service, Eastern Region
Hiawatha National Forest
January 2004

This Conservation Assessment was prepared to compile the published and unpublished information on *Carex concinna* R. Brown; This report provides information to serve as a Conservation Assessment for the Eastern Region of the Forest Service. It is an administrative study only and does not represent a management decision by the U.S. Forest Service. Although the best scientific information available was used and subject experts were consulted in preparation of this document and its review, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if the reader has any information that will assist in conserving this species, please contact the Eastern Region of the Forest Service – Threatened and Endangered Species Program at 310 Wisconsin Avenue, Suite 580 Milwaukee, Wisconsin 53203.

Draft *Carex concinna*

This document is undergoing peer review, comments welcome

Table of Contents

Acknowledgements	1
Introduction/Objectives	2
Executive Summary	2
Nomenclature and Taxonomy	3
Species Description	3
Geographic Distribution	4
Habitat and Ecology	5
Rangewide Protection Status	7
Life History	9
Population Viability	10
Potential Threats	10
Summary of Michigan Public Ownership	11
Management and Conservation Issues	12
Summary	12
References	13

Acknowledgements

Outside Reviewers – We would like to thank our academic reviewer outside of the U. S. Forest Service for his helpful comments and corrections on this manuscript.

- Tony Reznicek, Curator for Vascular Plants, University of Michigan Herbarium

Hanes Trust Fund – We thank the Hanes Trust for their support in funding this project.

Initial Draft – We are grateful to Beverly Braden, contract botanist, for her efforts in providing us with an original draft for this Conservation Assessment.

Herbarium and Heritage Data – We appreciate the sharing of occurrence information for this species from Heritage personnel both in the United States and Canada, along with the helpful assistance of Herbarium personnel. See Contacts section at end of report for a complete list.

Editorial Committee – We thank Jan Schultz, of the Hiawatha National Forest, for her suggestions and patience through numerous revisions.

Literature Search

- We thank Laura Hutchinson of the North Central Research Library for performing initial species inquiries and sending us relevant research articles.
- We thank Jan Schultz, of the Hiawatha National Forest, for use of her extensive library of materials to begin to compile information on this species.
- We thank Beverly Braden, a contract botanist, for additional literature searches at Northern Michigan University in Marquette, Michigan State University in East Lansing and University of Michigan in Ann Arbor.

Introduction/Objectives

The National Forest Management Act and USDA Forest Service policy and require that National Forest Service lands be managed to maintain viable populations of all native plant and animal species. A viable population is one that has established populations and a distribution of reproductive individuals sufficient to ensure the continued existence of the species throughout its range within a given planning area. In addition to those species listed as Endangered or Threatened under the Endangered Species Act, or Species of Concern by the U.S. Fish and Wildlife Service, the Forest Service lists species that are sensitive within each region – Regional Forester Sensitive Species (RFSS). A designation of “sensitive” affords some additional regulatory protection.

Carex concinna is a Regional Forester Sensitive Species (RFSS) in the Eastern Region of the National Forests. It is listed as an R9 (Region 9) sensitive species on the Hiawatha National Forest.

The objectives of this document are to:

1. Provide an overview of current scientific knowledge for this species.
2. Provide a summary of the distribution and status of this species, both rangewide and within the Eastern Region of the National Forests.
3. Provide the available background information needed to prepare a subsequent Conservation Approach.

Executive Summary

Carex concinna is a boreal plant known from Alaska and most of Canada to the St. Lawrence Seaway. In the United States it is found mostly in the western cordillera. This species of *Carex* exhibits a boreal affinity occurring from Alaska across all of Canada to Newfoundland. It is found in the mountains in the western United States and the along calcareous shores of the Great Lakes. In Michigan, it is most frequently found in gravelly calcareous shores near Lake Michigan and Lake Huron in both the Upper Peninsula and northern Lower Peninsula. Wisconsin Department of Natural Resources noted that this *Carex* species was difficult to identify in the field, and flowers and fruits early in the spring, thus it is likely overlooked. The largest threat to this plant in Michigan is the desirability of calcareous beach habitat for home and resort development along with increased recreational pressure by off-road vehicles.

Nomenclature and Taxonomy: (USDA NRCS 2001)

Family: Cyperaceae

Carex group: *Digitatae*

Scientific name: *Carex concinna* R. Br.

Synonym: none currently, historical entry *Edritria concinna* Raf. (1840)
(Hitchcock *et al.* 1969)

USDA NRCS Plant Code: CACO10

Common names: low northern sedge, beauty sedge, beautiful sedge

Species Description

Carex concinna (beauty sedge) is a slender, low-growing graminoid with stems 5-15cm tall, arising singly or a few together from a creeping rhizome. Leaves clustered near the base are about half the height of the culms. The terminal spike consists of staminate flowers only; the 2 or 3 pistillate spikes are clustered just below the terminal spike. Scales are distinctly shorter than perigynia. Perigynia are 2-3.5 mm long, plump, pubescent, and abruptly contracted to a short beak with three stigmas protruding (Markow & Fertig 2000).

Material for this section is from Mackenzie (1940), Robertson (1984), Hermann (1970), Hultén (1968), Gleason and Cronquist (1991), and Hitchcock *et al.* (1969), Crins 2002.

Habit: Loosely to densely caespitose or tufted perennial, or short rhizomatous

Rhizomes: Usually short or occasionally prolonged, scaly, slender brown-black

Culms: Smooth, very slender, lax, curved, 5.5 to 20 cm tall, with basal sheaths

Leaf sheaths: Straw-colored to reddish, leaf sheaths tight, concave

Leaves: Pale green, 5-9 in a fertile culm, 2-2.5 mm wide, flat to plicate with recurved margins, short acicular tip, margins serrulate on upper ½.

Staminate spike: One spike, 3.0-5.0 to 7.0 mm long, linear cylindrical, peduncled; staminate scales reddish brown, ovate, scarious.

Pistillate spikes: 2-3 lateral, 4.0 – 8.0 mm long, subglobose, loosely 6-12 flowered, often sessile or short-peduncled, pistillate scales dark-reddish-brown with white-hyaline margins and straw-colored or greenish midrib, ciliate, only half as long as perigynia.

Bracts: Subtending the lowest spike, with an expanded usually sheathing base 2.0 to 5.0 mm and an awn-tip of similar length.

Perigynia: Ascending, obtusely triangular to ellipsoid, 2-3.5 mm x 1-1.25 mm, membranous, pubescent with white coarse hairs, dull light brown, 2-ribbed, obscurely few-nerved, abruptly contracted to a short straight beak; beak chestnut-brown tinged, minute, obliquely cut, emarginate.

Achene: Triangular with convex sides, tightly filling perigynium, brown, style minute; stigmas 3, short, blackish. Fruits late May to late July.

Key (Gleason and Cronquist 1991).

Bracts of the pistillate spikes bladeless, consisting of the sheath only..... Group V

Group V

1. Staminate spike long-peduncled

2. Leaf blade 2-4 mm wide *Digitatae*

- 2. Leaf blade 10-25 mm wide *Laxiflorae*
- 1. Staminate spike sessile or nearly so

Digitatae

- 1. Pistillate scales conspicuously and abruptly cuspidate *C. pedunculata*
- 1. Pistillate scales rounded to obtuse or acute.
 - 2. Pistillate scales distinctly shorter than the perigynia *C. concinna*
 - 2. Pistillate scales equaling or surpassing the perigynia *C. richardsonii*

Similar species

Superficially, *Carex concinna* looks similar to *C. deflexa* Hornemann and *C. rossii* Boott of sect. *Acrocystis*. It differs from these species with its strongly sheathing, short-bladed bracts, perigynium indument of coarse, wrinkled hairs, and minutely ciliate pistillate scales (Crins 2002).

Geographic Distribution

Range-wide Distribution

Carex concinna is a boreal North American species that is known from Alaska and the Yukon Territory across Canada, east to Quebec and Newfoundland. It is common in northern Canada and Alaska, particularly in the western mountain ranges in the montane zone (Crins 2002). From Ontario it extends south to the Great Lakes states of Michigan and Wisconsin (MNFI 2002, WI Herbarium 2002). It is also known from the mountains of British Columbia south to Montana, Wyoming, Colorado and the Black Hills in South Dakota (Black Hills) (Markow and Fertig 2000).

Wynne-Edwards states that *Carex concinna* shows a cordilleran distribution which is essentially American. Species with a cordilleran distribution are absent from Greenland, northern Europe, and western Asia (Wynne-Edwards 1937). The shores of the Gulf of St. Lawrence harbor cordilleran plants preferring calcareous soils. Along with *Carex concinna*, *Anemone pariflora* and *Salix vestita* occur along the Gulf of St. Lawrence in calcareous soils (Wynne-Edwards 1937).

Region-wide Distribution

In the Great Lakes Region (Region 9 USDA Forest Service) *Carex concinna* is known from Michigan and Wisconsin. *Carex concinna* has not been documented in Minnesota (NatureServe 2001). *Carex concinna* occurs across Canada from Northwest Territories to Newfoundland (Scoggan 1978). In Ontario, it is known from the north shore of Lake Superior (Soper *et al.* 1989) and is abundant and widespread in the Hudson Bay Lowlands (Riley 1990 *cf.* Oldham 1993). In general as one moves north in Ontario, *C. concinna* becomes more frequent; the Warsaw Caves site in central Ontario is the most southerly location in Ontario (Oldham 1993). *Carex concinna* is also found on several islands of the Bruce Peninsula (Morton & Venn 1987) and Manitoulin Island

Habitat and Ecology

Boreal habitat

In Alaska and the Yukon Territories dry gravelly or sandy slopes or flats are typical habitats, but *C. concinna* also occurs in bogs and muskegs (Welsh 1974). In Canada this small sedge is a calciphile preferring coniferous woods, cool banks and mossy knolls (Oldham 1993).

In Canada where *Carex concinna* is more common, especially from 54°N to the Arctic Ocean, it is often found in dry coniferous forests in calcareous soils (Hultén 1968). Scoggan (1978) also emphasized that cool, calcareous woods and slopes were typical habitat. In Ontario, Oldham (1993) discovered *Carex concinna* growing in a carpet of *Carex eburnea* Boott at the base of a cliff, Warsaw Caves site in Peterborough County (central Ontario). The Warsaw Caves site in Ontario is one of the most southerly locations in eastern North America; this sedge is more common as one moves north in Ontario. A major post-glacial spillway ran through the Warsaw Caves site when subarctic climate dominated, which might explain *C. concinna* occurrence at this site (Oldham 1993).

Raymond (1951) studied the distribution of sedges in Quebec and considered *C. concinna* a high-subarctic species, one that penetrates into arctic regions in a portion of its range (Tans 1983). In Newfoundland and New Brunswick it is found in wetter sites. It is found in alder swamps in the western coastal plains of Newfoundland (Robertson 1984), while in New Brunswick it is known from sites long the Restigouche River such as calcareous ledges and shores (Hinds 1986).

Great Lakes limestone pavements or alvar

“The diversity and composition of plant species is largely determined by the distance from the edge of the water and the width of bedrock cracks. Soil accumulation begins in the cracks forming the first sites for vegetative colonization. Above the wave wash zone, a more densely vegetative zone extends inland to the forest edge” (Comer *et al.* 1997). *Carex concinna* occurs in this zone often near the conifer forest edge (MNFI 2002). “The width of this zone in Michigan averages 23m, and varies from 5-70m. Pools of standing water typically occupy about 1% of the surface area in this zone” (Comer *et al.* 1997). The soils and substrate are neutral to slightly alkaline (pH 6.7-8.0). Communities along the shorelines experience frequent high winds and storm events (Comer *et al.* 1997).

Characteristic plant species of the herb zone of limestone pavements include *Calamintha arkansana* (Arkansas mint), *Potentilla fruticosa* (shrubby cinquefoil), *Panicum lindheimeri* (panic grass), and *Deschampsia cespitosa* (hair grass). Other sedge species include *Eleocharis elliptica* (spikerush), *Carex eburnea* (ebony sedge), along with the more rare *Carex richardsonii* (Richardson’s sedge), *C. concinna* (beauty sedge), and *C. scirpoidea* (bulrush sedge).

Upper Peninsula alvar sites are mostly clustered along the shoreline of Lake Michigan and are described above as limestone pavements. The largest alvar (3200 hectares) occurs on Drummond Island on the northern portion of the island, Maxton Plains. Most of this area is owned by the State of Michigan. Within this community type, the Nature Conservancy (TNC) has a preserve. Michigan alvars account for approximately 15% of the Great Lakes total; whereas 2/3 of the total alvar area in the Great Lakes region is contained in Ontario. Ontario alvars are found on Manitoulin Island, the Bruce Peninsula, and several inland plains areas (Flamborough, Carden, Napanee, Smith's Falls) (TNC 1999).

Wisconsin

In Wisconsin this species occurs primarily in dune ridge and swale topography within the open, moist, sandy soil of Door County. *C. concinna* was first collected by Zimmerman (1954); he found it on damp, limestone beach ridges under white cedar and spruce in the Ridges Sanctuary, Door County. Another Door County site was discovered in 1974 near the Ridges Sanctuary at Pine Ledges (Marshalls Point). At Marshalls Point it occurs on low, somewhat dry, mossy ledges of Niagara dolomite partially shaded by balsam fir, white cedar, and white spruce (Tans 1983). This area encompasses 450 acres of pristine upland conifer forest on the south end of a dolomite headland projecting into Lake Michigan (Tans & Read 1975).

It is also known from the Apostle Islands in Ashland County along bluff edges (Judziewicz & Koch 1993). It is located on a disturbed (brushed) site on the north side of Devil's Island near the lighthouse (Tans 1983). Several of the plants occurring here are considered subarctic rarities including bird's-eye primrose (*Primula mistassinica*), butterwort (*Pinguicula vulgaris*), spike trisetum (*Trisetum spicatum*), hair-like sedge (*Carex capillaris*), and beautiful sedge (*C. concinna*) (Judziewicz & Koch 1993). Associated plant species at Apostle Islands include *Ledum groenlandicum*, *Alnus incana*, *Carex peckii*, *C. capillaris*, *C. aurea*, and *C. deflexa* (University of Wisconsin at Madison, 2002).

Michigan

Carex concinna is typically found in Michigan near the edges of northern white-cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*) thickets. It often occurs in a transition zone between beach and forest at the northern ends of Lake Michigan and Lake Huron (Voss 1968). The first collection in Michigan (Ehlers 1923) was from the northern Lower Peninsula at Big Stone Bay in Emmet County (Hermann 1941). Another early collection was made from limestone pavement on Drummond Island (Hiltunen 1962). On the Hiawatha National Forest, *Carex concinna* was found "sparsely scattered in shade of cedars in thick litter layer" (MNFI 1999).

In the northern Lower Peninsula of Michigan habitat is frequently listed as either cobble shore or found in the ecotone of calcareous shore and northern coniferous forest (MNFI 2002). In the Upper Peninsula habitat is often described as a shoreline fen/ boreal forest ecotone, or sand beach, or limestone pavement/ boreal forest ecotone. Alvar is the favored habitat in Schoolcraft and Chippewa counties (MNFI 2002).

Associated species near Lake Huron include bristle-leaved sedge (*Carex eburnea*), hairlike sedge (*C. capillaris*), twinflower (*Linnaea borealis*), and bearberry (*Arctostaphylos uva-ursi*) (Voss 1986). Other common associates include *Potentilla fruticosa* (shrubby cinquefoil), *Panicum lindheimeri* (panic grass), and *Deschampsia cespitosa* (hair grass) (Comer *et al.* 2000). Sedge species often associated with *C. concinna* include *Carex viridula*, and the more rare *C. richardsonii* (Comer *et al.* 2000). Associates at one of the Hiawatha National Forest sites are typical northern boreal species such as *Trientalis borealis*, *Coptis trifolia*, *Polygala paucifolia*, *Clintonia borealis*, and *Calypso bulbosa* (MNFI 1999).

Western United States

In the Rocky Mountains of the United States the habitat is listed as rich peaty soil in clearings or open woods, chiefly in calcareous areas at 5000 to 11000 feet (Hermann 1970). Colorado habitat is described as cool, moist forests with mosses at elevations of 8800-10500 feet (Colorado Natural Heritage Program 2002). Wyoming populations occur on mossy, well-drained soils by small streams at 6600-8000 feet. Surrounding forests are dominated by *Picea engelmannii* (Engelmann spruce) and *Picea glauca* (white spruce) (Wyoming Natural Diversity Database 2000).

Rangewide Protection Status (NatureServe)

Currently, the official status for *Carex concinna* R. Br. with respect to federal, state, and private agencies is:

U.S Fish and Wildlife Service: Not listed (None)

Global Heritage Status Rank: G4G5

U.S National Heritage Status Rank: N? (31Jul1993)

Canada Heritage Status Rank: N? (08Aug1993)

U.S. Forest Service:

Region 9 Sensitive on Hiawatha (MI)

Bureau of Land Management:

Region 2 Sensitive on BLM Lands in Colorado (BLM web site)

The Regional Forester (Forest Service) has identified it as a species for which viability is a concern on Hiawatha National Forest as evidenced by: **a)** it is at the southern edge of a more boreal range **b)** there is a decrease in preferred habitat (limestone beach cobble) due to private development **c)** previously natural fires may have created additional habitat suitable for this species (Hiawatha SVE 2003).

These ranks are defined as:

N?: Nationally uncertain either due to rarity, taxonomy or identification considerations.

G4: Nationally widespread or secure, but with cause for long-term concern.

G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.

United States (NatureServe 2001)

Alaska	SR	Oregon	S3
Colorado	S1	South Dakota	S3
Michigan	S3	Wisconsin	S1
Montana	SR	Wyoming	S1

Canada (NatureServe 2001)

Alberta	S5	Northwest Territories	SR
British Columbia	SR	Nunavut	SR
Labrador	SR	Ontario	S5
Manitoba	S4S5	Quebec	SR
New Brunswick	S2	Saskatchewan	S?
Newfoundland Island	SR	Yukon Territory	SR

Definition of State and Provincial Ranks:

S1 = Extremely rare; typically 5 or fewer known occurrences in the state; or only a few remaining individuals; may be especially vulnerable to extirpation.

S2 = Very rare; typically 5 between 6 and 20 known occurrences; may be susceptible to becoming extirpated.

S3 = Rare to uncommon; typically 21 to 50 known occurrences; S3 ranked species are not yet susceptible to becoming extirpated in the state, but may be if additional populations are put at risk.

S4 = Common, apparently secure under present conditions; typically 51 or more known occurrences, but may be fewer with many large populations; usually not susceptible to immediate threats.

S5 = Very common; demonstrably secure under present conditions.

SR = Reported from the state, but without persuasive documentation that would provide a basis for either accepting or rejecting the species.

S? = Not enough information available to assess at this time, more field studies and/or specimen identification is needed.

Life Cycle

Carex concinna is a herbaceous perennial of native origin (USDA NRSC 2001). The Hiawatha National Forest in Michigan's Upper Peninsula recommends a search time of mid-May through July, with June and early July being the most productive (HNF Search times matrix 2000). This sedge species flowers and fruits May-July in the western states (Hitchcock *et al.* 1969). *Carex concinna* fruits in June and July in the north-central and northeastern United States and adjacent Canada (Fernald 1950).

Research in Canada indicates that within some *Carex* species of arctic or alpine regions, primary induction of flowering shoots (development of floral primordia) begins in the fall and overwinters, while secondary induction (culm elongation and inflorescence development) occurs in the spring and summer (Bernard 1990). Additional research performed in Europe suggests flowering shoots may begin developing throughout the summer, although at a slower rate than the first shoots. Flowering shoots die after dehiscence, which is often within a year of development (Heide 1997). In regions with short growing seasons, flowering shoots may take multiple years to develop, depending on the conditions (Alexeev 1988).

Asexual reproduction in *Carex* species is normally by underground stems or rhizomes. *Carex concinna* sprouts from buds at the base of the culms (Britton & Brown 1970) and from rhizomes (Gleason & Cronquist 1991). Growth forms of *Carex* are determined largely by the type of rhizome produced. The most common growth form in *Carex* is probably where the plant produces both long, spreading and short clumping rhizomes as with *C. concinna*. "These species produce a matted and tufted growth pattern. The pattern is initiated by a shoot emerging at the end of a long rhizome; then short rhizomes develop to produce a tuft. The longer rhizomes enable the plant to exploit any open space quickly. At the same time, species using this strategy can employ favorable sites within the larger clonal area by forming tiller clumps" (Bernard 1990).

Tiller clumps may help hold the site against other species while producing a root system capable of providing nutrients for the tiller clump and shoots produced by long rhizomes. It is postulated that the life span of tiller clumps depends in part on nutrient availability. Alexeev (1988) estimated that arctic *C. aquatilis* tiller clumps lived for 4-10 years. Theoretically clones of many *Carex* species may survive for hundreds of years by growing at one end and dying at the other. In order to predict longevity at a site, the behavior of genets, clumps and shoots needs to be understood along with the likelihood of flowering (Bernard 1990).

In an experiment with fen species including several *Carex* species, percentage of seed germination ranged from 31% (*Carex nigra*) to more than 95% (*Carex curta*) (Bekker *et al.* 1998). Germination rates specific for *Carex concinna* were not reported in the literature. With *Carex curta* and *Carex echinata* there was not significant viability loss among seeds from 1995 to 1996 (Bekker *et al.* 1998). It may be that the small size and hardness of these achenes protects them from loss of viability when buried in the soil. Experiments with *C. concinna* are needed to determine if this pattern is reliable for this species as well.

In a study of European temperate *Carex* species, Schütz & Rave (1999) determined that 70-80% of the 32 species had increased germination rates after a period of cold stratification. Most species required light for germination. Heide (1997) germinated arctic or alpine species of *Carex* by first refrigerating imbibed achenes at 5 °C for 4 weeks; then achenes were germinated under fluctuating day/night temperatures (21/9 °C, 8/16 hours).

Population Biology and Viability

In the midwest, *Carex concinna* has a distinct distribution around the northern Great Lakes. It occurs both in the northern Lower Peninsula and the Upper Peninsula of Michigan and in Ontario along the northern shoreline of Lake Superior. In Wisconsin it is known only from the Door Peninsula (Lake Michigan) and the Apostle Islands (Lake Superior) (Tans 1983). It appears that the Great Lakes provide the cooler more humid climate that this sedge seems to require. When conditions are favorable such as at the Ridges Sanctuary on the Door Peninsula sizable populations can be found and have remained for many decades.

It is very likely that this sedge has been overlooked since it is low, inconspicuous and fruits early in the summer (Tans 1983). In Michigan, many new locations have been found in the 1990's (MNFI 2002). In 1972, *Carex concinna* was known only from Emmet, Chippewa (including Drummond Island), and Delta counties (Voss 1972). Several Upper Peninsula locations were documented since then in Mackinac, and Schoolcraft counties. In the Lower Peninsula element occurrences are now known for Charlevoix, Leelanau, and Presque Isle, plus additional element occurrences for Emmet County (MNFI 2002). Overall it would appear that population viability is not being currently threatened. Probably the greatest threats are those issues that effect Great Lakes limestone pavements; see the "Potential threats" section.

Potential Threats

"Residential subdivision of adjacent uplands frequently leads to degradation of limestone pavement communities through trampling, off-road vehicle use, and possible water pollution due to runoff" (Comer *et al.* 1997). The flat, open terrain of some alvar areas attracts trail bikes and ATV enthusiasts, causing ruts that disrupt water flow patterns (TNC 1999). Also the sparse open vegetation of these areas makes them susceptible to invasion by non-native plants.

Logging of adjacent forests can alter the vegetation structure at a site. In some locations alvars have been used as skidways and log assembly areas resulting in serious damage and increased debris accumulation (TNC 1999).

Global warming could be a threat for this species as it is already in low numbers and at the southern edge of its United States range. Scientists throughout the world have predicted that a worldwide warming trend will continue to increase in the coming century

(Primack 1993; Levitus *et al.* 2001). As the climate continues to warm, it is predicted that the distributions of northern-hemisphere plant species may “migrate” to the north. *Carex concinna* is near the southern edge of its range in northern Wisconsin, and northern Michigan. If the climate in the Great Lakes Region warms, this species could be at risk. Monitoring of known sites would help assess long-term viability.

In the western United States, cattle and horse grazing have been documented in the Wind River Range population of Wyoming (Fertig 1992 *cf* Markow & Fertig 2000). In Canada, cattle grazing and limestone rock quarrying are threats to Great Lakes alvars (TNC 1999).

Since *Carex concinna* can reproduce vegetatively it likely sprouts from rhizomes after aerial portions are burned thus it may benefit from a light fire. Its thick tufts function to protect basal buds from fire-caused damage (USDA FS 1994). In many regions of the country suppression of fire has caused previously open areas to become encroached by the forest edge.

Summary of Michigan Occurrences within public ownership and TNC

Lake Superior State Forest (State of Michigan) – 6 occurrences	
Wilderness State Park (State of Michigan) – 5 occurrences	
Mackinaw State Forest (State of Michigan) – 2 occurrences	
Hiawatha National Forest (USDA Forest Service) – 2 occurrences	
Thompson Harbor Natural Area (TNC) – 1 occurrence	
Sleeping Bear Dunes (National Park Service) – 1 occurrence	
Maxton Plains on Drummond Island (TNC has a preserve on part of this extensive area of State-owned land)	
Total	16 of 45 state-wide occurrences

Sixteen of 45 state-wide occurrences or 1/3 of all occurrences are within ownership that could potentially provide some protection. Public or TNC ownership does not mean that the site is entirely protected. Protection from fragmentation and urban development is the most clearly afforded protection. Only two areas are set aside strictly as a natural areas. Monitoring efforts are necessary to determine whether the preserves should be managed by controlled burns, or exotic weed removal is necessary (TNC 1999). Wilderness State Park restricts access to portions of their beaches due to nesting Piping Plovers; limited use by visitors would thus also protect sensitive plant species in the area.

Both State and Federal Forests often focus on timber production. Plants are at least protected from severe fragmentation of lands, but forest roads often cause some fragmentation. Forest logging practices could result in habitat losses, and the introduction of weeds due to soil disturbance caused by skidding. Road building often results in fragmentation of the area, plus invites more recreational use such as off-road vehicles (J. Schultz pers. comm. 2002).

Management and Conservation Issues

Carex concinna is a low growing inconspicuous sedge of mostly more northerly habitats. More surveys are needed in likely areas to determine its rarity. Studies on aspects of its life history are also needed. In Michigan, conservation management will likely focus on protecting limestone pavement from increased recreational impact and possible hydrological disturbance caused by second home development, ATV traffic, and forest overstory removal close to Great Lakes shorelines.

Summary

Carex concinna is a low growing, boreal plant known from Alaska and most of Canada to the St. Lawrence Seaway. In the Great Lakes region it is mostly found on the calcareous shores, both in the States and in Ontario. In Michigan it is most frequently found in gravelly calcareous shores near Lake Michigan and Lake Huron in both the Upper Peninsula and northern Lower Peninsula. In Wisconsin it is known from dune swale topography on the Door Peninsula. The Wisconsin Department of Natural Resources noted that this *Carex* species was a difficult species to identify in the field thus it might be overlooked. The largest threat to this plant in Michigan is the desirability of calcareous beach habitat for homes and increased recreational use via ATVs, etc. that are often associated with increasingly easy access. As global warming continues, these sites will need to be closely monitored to see if they appear to be adversely affected by gradual climate change.

References

- Alexeev, Y.E. 1988. Ontogenesis in *Carex* species. *Aquatica Botany*. Vol. 30: 39-48.
- Bekker, R.M., I.C. Knevel, J.B. Tallowin, E. M. Trosst, and J.P. Bakker. 1998. Soil nutrient input effects on seed longevity: a burial experiment with fen-meadow species. *Functional Ecology* 12: 673-682.
- Bernard, J.M. 1990. Life history and vegetative reproduction in *Carex*. *Canadian Journal of Botany*. 68: 1441-1448.
- Britton, N.L. and A. Brown. 1970. *An Illustrated Flora of Northern United States and Canada*. Dover Publication. New York. p. 395.
- Comer, P.J., D.L. Cuthrell, D.A. Albert, and M.R. Penskar. 1997. Natural community abstract for limestone/dolostone pavement lakeshore. *Michigan Natural Features Inventory*. Lansing, MI. 3 pp.
- Crins, W.J. 2002. *Carex* Linnaeus sect. *Clandestinae* in *Flora of North America*. Vol. 23. New York. Oxford University Press. p. 546-548.
- Fasset, N. 1976. *Spring Flora of Wisconsin*. The University of Wisconsin Press. P. 46.
- Fernald, M.L. 1950. *Gray's Manual of Botany*. Dioscorides Press. Portland, Oregon. P. 342.
- Gleason, H. A. and A. Cronquist. 1991. *Manual of Vascular Plants of Northeastern United States and Adjacent Canada*. New York Botanical Garden. P. 693-721.
- Great Plains Flora Association. 1986. *Flora of the Great Plains*. University Press of Kansas at Lawrence, Kansas. P. 1074.
- Heide, O.M. (1997) Environmental control of flowering in some northern *Carex* species. *Ann. Bot.*, 79; pp. 319-327.
- Hermann, F.J. 1941. *Carex* in Michigan. *The American Midland Naturalist*. Vol 25. P.36.
- Hermann, F.J. 1970. *Manual of the Carices of the Rocky Mountains and Colorado Basin*. UDSA Forest Service. Agricultural Handbook No. 374. P. 229.
- Hiltunen, J.K. 1962. Notes on the Flora of Chippewa County, Michigan. *The Michigan Botanist*. Vol. 1(1): 23-25.

- Hinds, H.R. 1986. Flora of New Brunswick. University of New Brunswick. Fredericton, New Brunswick. P. 98.
- Hitchcock, C.L., A. Cronquist, M. Ownbey, and J.W. Thompson. 1969. Vascular Plants of the Pacific Northwest. Seattle, University of Washington Press. p. 255-257.
- Hultén, E. 1968. Flora of Alaska and Neighboring Territories. Stanford University Press at Stanford, California. P. 267.
- Judziewicz, E.J. and R.G. Koch. 1993. Flora and vegetation of the Apostle Islands National Lakeshore and Madeline Island, Ashland and Bayfield counties, Wisconsin. The Michigan Botanist. Vol 32(2) p. 43, 66, 80.
- Levitus, S. and J.I. Antonov, J. Wang, T.L. Delworth, K.W. Dixon, A.J. Broccoli. 2001. Anthropogenic warming of the Earth's climate system; Science. Vol. 292, pp. 267-270.
- Mackenzie, K. 1940. North American Cariceae. 2 Vols. New York Botanical Garden, New York.
- Markow, S. and W. Fertig. 2000. Wyoming species abstract – *Carex concinna*. Wyoming Natural Diversity Database. P. 1-3.
- Michigan Natural Features Inventory (MNFI). 2002. Michigan State University Extension Electronic Database. Database updated May 28, 2002. <http://web4.msue.msu.edu/mnfi/search/results.cfm>
- Michigan Natural Features Inventory (MNFI). 1999. Element Occurrence Record for the Hiawatha National Forest.
- Morton, J.K. and J. M. Venn. 1987. Flora of the Tobermory Islands. Bruce Peninsula National Park. University of Waterloo. Waterloo, Canada. p. 34.
- Morton, J.K. and J. M. Venn. 1990. A checklist of the Flora of Ontario Vascular Plants. University of Waterloo. Waterloo, Canada. p. 34.
- Oldham, M. J. 1993. *Carex concinna* (Cyperaceae) new to Peterborough County, Ontario. Field Botanist of Ontario Newsletter (Summer) Vol. 6(2) p. 13-14.
- Primack, R.B. 1993. Essentials of Conservation Biology. Sinauer Associates, Inc. Sunderland, Massachusetts. p. 157-161.
- Riley, J.L. 1990. The Vascular Plants of the Hudson Bay Lowland, and their Postglacial Origins. Parks and Recreational Areas Section. Ontario Ministry of Natural Resources, Central Region, Aurora. 222p.

- Robertson, A. 1984. *Carex* of Newfoundland. Newfoundland Forest Research Centre. P. 116, 235.
- Schütz, Wolfgang and Rave, Gerhard. (1999) The effect of cold stratification and light on the seed germination of temperate sedges (*Carex*) from various habitats and implications for regenerative strategies. *Plant Ecol.*, 144; pp. 215-230.
- Scoggan, H.J. 1978. The Flora of Canada (Part 2). National Museum of Canada. p. 387.
- Soper, J.H., C.E. Garton and D.R. Given. 1989. Flora of the North Shore of Lake Superior. *Syllogeus* 63. National Museum of Natural Sciences, Ottawa. 81p.
- Tans, W.E. 1983. Recent Wisconsin records for some interesting vascular plants in the western Great Lakes Region II. *The Michigan Botanist*. 22:11-17.
- Tans, W.E. and R.H. Read. 1975. Recent Wisconsin records for some interesting vascular plants in the western Great Lakes Region. *The Michigan Botanist*. Vol 14(3) pp. 131-138.
- The Nature Conservancy (TNC). 1999. Great Lakes Alvars. Federation of Ontario Naturalists and The Nature Conservancy Great Lakes Program. Pp. 1-33.
- USDA Hiawatha National Forest. 2003. Species Viability Evaluation (SVE) Documentation. P. 96-98.
- University of Michigan Herbarium. 2002. Information from specimen labels copied by Beverly Braden.
- University of Wisconsin Herbarium. 2002. Wisconsin element occurrences with habitat information. Contact: mblack@facstaff.wisc.edu
- USDA Forest Service. 2000. Hiawatha National Forest Rare Plants—Community Associations and Search Times Matrix.
- Voss, E.G. 1978. Michigan Flora (Vol. 1). Cranbrook Institute of Science. Bloomfield Hills, Michigan. P. 290.
- Welsh, S.L. 1974. Anderson's Flora of Alaska and Adjacent Parts of Canada. Brigham Young University Press at Provo, Utah. P. 504.
- Wilson, B.L., R. Brainerd, M. Huso, K. Kuykendall, D. Lytjen, B. Newhouse, N. Otting, S. Sunberg and P. Zika. 1999. Atlas of Oregon *Carex*. Native Plant Society of Oregon, Occasional Paper No. 1. Corvallis, Oregon. 29 pp.
- Wisconsin Department of Natural Resources. 1993. Guide to Wisconsin's Endangered and Threatened Plants. Bureau of Endangered Resources. PUBL-ER-067 p. 28.

Wynne-Edwards, V.C. 1937. Isolated Arctic-Alpine floras in Eastern North America: A discussion of their glacial and recent history. Transactions of the Royal Society of Canada. Section V, 1937:33-58.

Web sites

Colorado – Bureau of Land Management. 2000. State Director's Sensitive Species List.
<http://www.blm.gov/nhp/efoia/co/00ibs/ib00-014.htm>

Colorado Natural Heritage Program. 2001. Rare Plant Field Guide – *Carex concinna*
<http://ndis.nrel.colostate.edu/ndis/rareplants/PMCYP03300.html>

Checklist of the Vascular Plants of Akimiski Island, Nunavut Territory
<http://www.erin.utoronto.ca/~w3pkota/akiplants.html>

Michigan Natural Features Inventory (MNFI) 2002. Electronic database query:
<http://web4.msue.msu.edu/mnfi/search/>

University of Wisconsin herbarium
<http://wiscinfo.doit.wisc.edu/herbarium/scripts/detail.asp?SpCode=CARCONI>

USDA Forest Service. 1994. *Carex concinna* in Fire Effects Database
<http://www.fs.fed.us/database/feis/plants/graminoid/carcoc/all.html>

USDA NRCS Plant Profile
Wysiwyg://access_body.33/http://plantsgov/plants/cgi_bin/plant_search.cgi

Wallowa-Whitman NF 2000. Oregon Watch List Species
<http://www.eou.edu/~kantell/biol334i.html>

Weaselhead Glenmore Park. Calgary, Alberta.
<http://weaselhead.org/learn/floweringplants.htm>

Picture:
Cyber Sedge. Texas A & M University. Bioinformatics Working Group.
Illustration initially from Kenneth Kent Mackenzie (1940) North American Cariceae
<http://www.csdl.tamu.edu/FLORA/carex/k2325900.htm>

Contacts

Database Managers or Contacts for State Natural Heritage Programs (August 2001)
Wisconsin: Merel Black, University of Wisconsin at Madison, mblack@facstaff.wisc.edu
Michigan: Edward Schools (GIS): schoolse@michigan.gov
Michigan: Michael Penskar (Botany) [penskar@michigan.gov](mailto:penskarm@michigan.gov)

USDA Forest Service Contacts (August 2001)

Hiawatha National Forest, MI: Jan Schultz (Forest Plant Ecologist) (906-228-8491)

jschultz@fs.fed.us

Library Services, MN: Laura Hutchinson

lhutchinson@fs.fed.us

Appendix for *Carex concinna*

Hiawatha National Forest (Upper Peninsula of Michigan) (MNFI 1999)

Location	Date Last Observed	Remarks
Pontchartrain shores, Mackinac County	June 13, 1997	At least 6 clumps, sparsely scattered in shade of cedars in thick litter layer on gentle slopes.
Pontchartrain shores, Mackinac County	June 25, 1996	Scattered population

Michigan - Other Upper Peninsula Locations (MNFI electronic database 2002)

Counties (Chippewa, Delta, Mackinac, Schoolcraft)

Location/ County/ Public ownership	Date Last Observed	Remarks
Marquette Bay, Mackinac	June 09, 1999	Boreal forest / northern fen
Voight Bay, Mackinac	June 10, 1999	Interdunal wetland edge
Lasalle Island, Mackinac	June 11, 1999	Boreal forest
Marquette SE Peninsula, Mackinac	June 11, 1999	Ecotonal region between open fen and shoreline ridges
Bois Blanc Island, Mackinac	June 02, 1973	6 element occurrences on island, locally common with <i>Iris lacustris</i> .
Marblehead, Chippewa Lake Superior State Forest	July 15, 1999	Dry non-acid cliff
Sweet's Point, Chippewa	May 28, 1957	
Drummond Island, Chippewa	July 02, 1961	On limestone pavement with <i>Carex capillaris</i> and <i>Carex eburnea</i>
Big Shoal Cove, Chippewa	June 19, 1979	Drummond Island, locally frequent under conifers on low dunes with <i>Cypripedium arietinum</i> and <i>Carex richardsonii</i> .
Detour Passage, Chippewa	June 18, 1979	Open glades in <i>Abies/Thuja</i> woods
Strawberry Island, Chippewa	June 06, 1981	(Penskar & Ludwig)
Lake Superior State Forest, Chippewa	May 25, 1993	Alvar openings
Summer Island, Delta	May 31, 1968	Locally abundant along shore

		forming large mats (Voss).
Portage Bay Campground, Delta Lake Superior State Forest	June 11, 1974	
Poverty Island, Delta	June 21, 1995	Boreal forest with <i>Carex eburnea</i>
Summer Island, Delta	June 23, 1995	Alvar, locally abundant (Voss 1985)
Seul Choix Point, Schoolcraft	June 06, 2000	Ecotone of boreal forest / limestone pavement
Hiram Point South, Schoolcraft	August 08, 2000	Shoreline fen/ boreal forest ecotone
Parent Bay, Schoolcraft	August 09, 2000	Ecotone of boreal forest /sand beach

Note: The Emmet County collection by Ehlers (1923) near Big Stone Bay was the first collection for Michigan and remained the only known collection for about 20 years (Hermann 1941). Even at the time of Voss first volume (1968), *C. concinna* was known only from Chippewa, Delta and Emmet counties, along with Drummond Island.

Michigan – Lower Peninsula Locations (MNFI 2002) (Univ. of Michigan Herb. 2002)
Counties (Alpena, Charlevoix, Emmet, Leelanau, Presque Isle)

Location/ County/Ownership	Date Last Observed	Remarks
Middle Island, Alpena	July 14, 1972	One colony
Garden Island, Charlevoix Mackinaw State Forest	May 22, 1999	Cobble shore
Jensen Harbor West, Charlevoix Mackinaw State Forest	May 22, 1999	Open dune/ cobble shore
Garden Island, Charlevoix	August 18, 1999	Weedy open dune/ boreal forest
Beaver Island, Charlevoix	August 08, 1989	Cobble shore
Big Stone Bay, Emmet Wilderness State Park	August 05, 1923	Roadside within moist woods, 5 EOs
McGulpin Point, Emmet	June 04, 1968	Fir woods / calcareous shore ecotone
Trail's End Bay, Emmet	June 20, 1969	Fir/balsam thicket & calcareous shore; locally frequent with <i>Iris lacustris</i>
Sleeping Bear Dunes National Lakeshore, Leelanau	May 27, 1984	A dry gravelly ridge through a <i>Thuja</i> forest at the base of dunes
Grand Lake, Presque Isle	May 16, 1977	Old beach ridge slope in rocky limestone at clearing
Presque Isle Harbor, Presque Isle	June 07, 1990	<i>Abies/Picea</i> forest; thin soil on rocky limestone knoll
Thompson's Harbor Natural Area, Presque Isle	June 27, 1996	A limestone cobble shore with <i>Carex capillaris</i> , <i>Carex eburnea</i> , <i>Juncus balticus</i> , <i>Tofieldia glutinosa</i> , and <i>Castilleja coccinea</i>

Additional element occurrences (University of Michigan Herbarium 2002)

Location/ County	Date Last Observed	Remarks
------------------	--------------------	---------

Alpena (White Fish Bay)	1987	Limestone derived sand-gravel with <i>Iris lacustris</i> and <i>Carex eburnea</i>
Delta – Garden Peninsula	1983	Locally frequent on gravelly beach ridges; NE of Fairport
Emmet	1923	Roadside through moist woods
Mackinac	1992	A few plants with <i>Iris lacustris</i> on first stable semi-shaded dune.
Mackinac	1980 (Voss)	Very local on dry mound in cedar/tamarack swamp

Wisconsin (University of Wisconsin at Madison, 2002)

County	Date Last Observed	Remarks
Ashland	June 13, 1977	Upland disturbed area, bluff edges
Door	June 20, 1980	Shaded beach ridge
Door	June 28, 1987	Shaded soil along swale
Door	July 1, 1987	Shaded sandstone cliff
Door	July 24, 1989	Small canopy opening in mossy <i>Thuja/ Picea glauca</i> forest with <i>Iris lacustris</i>
Door	June 26, 1973	Boreal forest on low limestone ledge

Associates at Ashland, WI site: *Ledum groenlandicum*, *Alnus crispa*, *Carex peckii*, *Carex capillaris*, *Carex deflexa* (University of Wisconsin at Madison, 2002).

WI habitat: primarily ridge and swale complex (WI DNR 2001); at Apostle Islands it is noted as scattered populations at the north tip of bluff edges (Judziewicz & Koch 1993).

Minnesota: Never collected in state (NatureServe 2002)

Western States

Oregon: isolated stations in Willowa Mountains (Hitchcock et al. 1969)

Mossy bogs, springs and seeps in Willowa-Whitman National Forest (2001).

Montana: Glacier National Park has reproducing population (Univ. of Calif. 2001)

Wyoming: (Yellowstone Nat. Park) and two counties (Park and Sublette) in the western portion of state (Rocky Mountain Herbarium 1998); known from Absaroka and Wind River ranges along with Yellowstone Plateau (Markow and Fertig 2000).

Colorado: Cool, moist forests with mosses on rich peaty soil, often calcareous. Elevation 8800-10500 feet, 3 counties (Colorado Natural Heritage Program 2001).

South Dakota (Black Hills): dry soil (Flora of the Great Plains 1986).

Two counties in western portion of state (USDA NRCS 2001)

Alaska (North Central to eastern sections) (Scoggan 1978, Hulten 1968).

- Gates of the Arctic National Park

- Yukon-Charley Rivers Natural Preserve

Canada

Yukon and NW Canada: from 54°N to the Arctic Ocean (Hultén 1968). Stony, dry places in forest, preferably in calcareous soil (Hultén 1968).

British Columbia: Forested conifer woods in Selkirk Mountains (Hitchcock 1969).

Alberta and Saskatchewan: Mackenzie River Delta, Great Bear Lake, Great Slave Lake, Lake Athabasca (Scoggan 1978). Mackenzie River specimen collected by Sir John Richardson in 1823 may be a type specimen (New York Botanical Garden 2002). Recently found in Weaselhead Glenmore Park in Calgary, Alberta (Park Web site 2002).

Manitoba: North to Churchill (Scoggan 1978). “At base of ledge of rocks in sparse spruce timber, northwestern extremity of Nueltin Lake” (Cody 1978). At the time of publication was the only known specimen from the District of Keewatin (northern Manitoba).

Ontario (northern):

An uncommon sedge in dry places at the forest edge on several islands of the Bruce Peninsula (Morton & Venn 1987).

Quebec:

North to the Larch River (56°N), Lake Mistassini, and Cote-Nord (Scoggan 1978).

Newfoundland:

Rare, found in alder swamps and *Abies balsamea* forests in the western coastal plains (Robertson 1984).

New Brunswick: Rare, known from a few sites along the Restigouche River in Restigouche County and Madawaska County and two sites in Victoria County (Hinds 1986).